DRAFT INTERNATIONAL STANDARD ISO/DIS 15859-6

ISO/TC **20**/SC **14** Secretariat: **ANSI**

Voting begins on **2002-09-12** Voting terminates on **2003-02-12**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Space systems — Fluid characteristics, sampling and test methods —

Part 6:
Monomethylhydrazine propellant

Systèmes spatiaux — Caractéristiques des fluides, échantillonnage et méthodes d'essai —
Partie 6: Monométhyle hydrazine (carburant)

ICS 49.140

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 15859 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15859-6 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 15859 consists of the following parts, under the general title *Space systems — Fluid characteristics, sampling, and test methods*:

— *Part 1: Oxygen*

— *Part 2: Hydrogen*

— *Part 3: Nitrogen*

— *Part 4: Helium*

— *Part 5: Nitrogen tetroxide propellants*

— *Part 6: Monomethylhydrazine propellant*

— *Part 7: Hydrazine propellant*

— *Part 8: Kerosine propellant*

— *Part 9: Argon*

— *Part 10: Water*

— *Part 11: Ammonia*

— *Part 12: Carbon dioxide*

— *Part 13: Breathing air*

Introduction

This International Standard specifies limits for the composition of monomethylhydrazine (N_2H_3 CH_3) (MMH) and establishes the fluid sampling and test methods for monomethylhydrazine propellant intended for use as a fuel in the propulsion system of space systems. The purpose of this International Standard is to establish uniform requirements for the composition of MMH and the sampling and test methods for monomethylhydrazine used in the servicing of launch vehicles, spacecraft, and ground support equipment.

Fluid operations at a spaceport or launch site may involve a number of operators and supplier/customer interfaces, from the fluid production plant to the delivery to the launch vehicle or spacecraft. The fluid composition limits specified in this International Standard are intended to define the purity and impurity limits of the fluid for loading into the launch vehicle or spacecraft. The fluid sampling and test methods included in this International Standard are intended to be applied by any operator. The fluid sampling and test methods presented in this International Standard are acceptable methods for verification of the fluid composition limits.

Space systems — Fluid characteristics, sampling and test methods —

Part 6:
Monomethylhydrazine propellant

1 Scope

This part of ISO 15859 specifies limits for the composition of monomethylhydrazine and defines the fluid sampling and applicable test methods for verification of monomethylhydrazine (MMH) composition. This International Standard establishes acceptable composition, test, and sampling requirements. This part of ISO 15859 is applicable to monomethylhydrazine propellant of the following grades, intended for use as a fuel in propellant systems of space systems.

CAUTION — Monomethylhydrazine, in the liquid or vapor form, is toxic and volatile. Care should be taken in the handling and storage of monomethylhydrazine to prevent contact with the human body and with materials that are not compatible with monomethylhydrazine.

— grade A: 98,0 % pure;

— grade F: 98,5 % pure.

This part of ISO 15859 is applicable to propellant used in both flight hardware and ground facilities, systems, and equipment. It is applicable to influents only to the extent specified herein.

This part of ISO 15859 is applicable to any sampling operation required to ensure that, when the fluid enters the launch vehicle or spacecraft, the fluid composition complies with the limits provided hereafter or with any technical specification agreed to for a particular use.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15859. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15859 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8402:1994, *Quality management and quality assurance — Vocabulary.*

3 Terms and definitions

For the purposes of this part of ISO 15859, the terms and definitions given in ISO 8402 and the following apply:

3.1
particulate matter
undissolved solids retained on a filter paper with a 10 μm nominal and 40 μm absolute rating

3.2
verification tests
analyses performed on the fluid in the container, or a sample thereof, which is representative of the supply

4 Composition

4.1 Limits

Unless otherwise provided in an applicable technical specification, the composition of MMH propellant delivered to the flight vehicle interface shall be in accordance with the limits given in Table 1 when tested in accordance with the applicable test methods.

Table 1 – Composition limits

Composition		Limits	
		Grade A	Grade F
Monomethylhydrazine assay	mass fraction, %, min.	98,0	98,5
Water	mass fraction, %, max.	2,0	0,5
Particulate matter	mg/L, max.	10	10
Sodium	µg/g, max.	—	2
Ammonia (NH_3)	mass fraction, %, max.	—	0,2
Monomethylamine	mass fraction, %, max.	—	0,3

4.2 Qualitative properties

The propellant shall be a homogeneous liquid when examined visually by transmitted light.

4.3 Procurement

The MMH grades specified in Clause 1 should be procured in accordance with an applicable national standard.

5 Fluid sampling

5.1 Plan

In order to ensure that the fluid composition complies with the limits specified in this International Standard, a fluid sampling plan should be established by all the involved operators, from the production to the space vehicle interface, and approved by the final user. Such plan shall specify:

— the sampling points;

— the sampling procedures;

— the sampling frequency;

— the sample size;

— the number of samples;

— the test methods;

— the responsibilities of any involved operator.

CAUTION — Monomethylhydrazine, in the liquid or vapor form, is toxic and volatile. Care should be taken in the handling and storage of monomethylhydrazine to prevent contact with the human body and with materials that are not compatible with monomethylhydrazine.

5.2 Responsibility for sampling

Unless otherwise provided in an applicable technical specification, the monomethylhydrazine delivered to the flight vehicle interface shall be sampled and verified by the supplier responsible for providing the monomethylhydrazine to the flight vehicle. The supplier may use its own or any other resources suitable for the performance of the verification tests specified herein unless otherwise directed by the customer.

5.3 Sampling points

Unless otherwise specified, sampling shall be conducted at the fluid storage site or the flight vehicle interface.

5.4 Sampling frequency

Sampling shall be annually or in accordance with a time agreed upon by the supplier and the customer.

5.5 Sample size

The quantity in a single sample container shall be sufficient to perform the analysis for the limiting characteristics. If a single sample does not contain a sufficient quantity to perform all of the analyses for the required quality verification test, additional samples shall be taken under similar conditions.

5.6 Number of samples

The number of samples shall be in accordance with one of the following:

a) one sample per storage container;

b) any number of samples agreed upon by the supplier and the customer.

5.7 Storage container

Unless otherwise provided by the applicable sampling plan, the fluid storage container shall not be refilled after the time the sample is taken.

5.8 Liquid samples

Liquid samples shall be a typical specimen from the liquid monomethylhydrazine supply. For safety reasons, the sample container and sampling system must have a rated service pressure at least equal to the pressure in the supply container. Samples shall be obtained in accordance with one of the following:

a) by filling the sample container and storage containers at the same time, on the same manifold, and under the same conditions and with the same procedure;

b) by withdrawing a sample from the supply container through a suitable connection into the sample container.

5.9 Rejection

When any sample of the fluid tested in accordance with Clause 6 of this International Standard fails to conform to the requirements specified herein, the fluid represented by the sample shall be rejected. Disposition of the rejected fluid shall be specified by the customer.

6 Test methods

6.1 General

The supplier will ensure, by standard practice, the quality level of monomethylhydrazine. If required, alternate test methods are described in Clause 6 of this International Standard. Other test methods not listed in this International Standard are acceptable if agreed upon between the supplier and the customer.

These tests are a single analysis or a series of analyses performed on the fluid to ensure the reliability of the storage facility to supply the required quality level. This can be verified by analysis of representative samples of the fluid from the facility at appropriate intervals as agreed upon between supplier and the customer. Tests may be performed by the supplier or by a laboratory agreed upon between the supplier and the customer.

The analytical requirements for the tests shall include the determination of all limiting characteristics of monomethylhydrazine.

6.2 Parameters of analysis

The parameters for analytical techniques contained in this section are:

a) purity and impurity contents shall be expressed as a percentage (%) by weight unless otherwise specified;

b) calibration standards containing the applicable liquid components may be required to calibrate the analytical instruments used to determine the limiting characteristic levels of fluid;

c) if required by the customer, the accuracy of the measuring equipment used in preparing these standards shall be traceable to an established institute for standards;

d) analytical equipment shall be operated in accordance with the manufacturer’s instructions;

e) analytical methods not listed in this International Standard are acceptable if agreed upon between the supplier and the customer.

6.3 Monomethylhydrazine purity

The monomethylhydrazine concentration shall be determined by a gas chromatographic method. This method may be used not only for monomethylhydrazine determination but also for the determination of water, ammonia, and monomethylhydrazine. The analyzer shall be capable of separating and detecting the component with a sensitivity of 10 % of the specified maximum amount of the component. The analyzer shall be calibrated at appropriate intervals by the use of calibration standards.

6.4 Water content

The water content shall be determined by the following method:

The water content shall be determined by a gas chromatographic method such as described in 6.3 of this International Standard.

6.5 Particulate matter content

The particulate matter content shall be determined by a gravimetric measurement method. A known volume of fuel is filtered through a preweighed test membrane filter and the increase in membrane filter weight is determined after washing and drying. The change in weight of a control membrane filter located immediately below the test membrane filter is also determined. The particulate contaminant is determined from the increase in weight of the test membrane filter relative to the control membrane filter.

6.6 Sodium content

The sodium content shall be determined by one of the following methods:

a) by an atomic absorption spectrometric method;

b) an inductively coupled argon plasma emission spectrometric method.

The sodium content cannot be measured directly in the liquid MMH sample but from a nonvolatile residue after dissolving it in an aqueous solution or an aqueous acid solution.

6.7 Ammonia content

The ammonia content shall be determined by a gas chromatographic method such as described in 6.3 of this International Standard.

6.8 Monomethylamine content

The monomethylamine content shall be determined by a gas chromatographic method such as described in 6.3 of this International Standard.

Annex A
(informative)

Gaseous chromatography (GC) applications

Gaseous chromatography (GC) should be used as the reference or preferred method to analyze some monomethylhydrazine impurities, for example, water, ammonia, and monomethylamine, and monomethylhydrazine purity control.

Table A.1 summarizes the applications of these methods for monomethylhydrazine.

Table A.1 - Application of GC

Characteristic	**Application**
	GC with TCD detector
MMH purity	GC with TCD detector, on PEG 400 or QUADROL column (or equivalent)
Water	GC with TCD detector, on PEG 400 or QUADROL column (or equivalent)
Ammonia	GC with TCD detector, on PEG 400 or QUADROL column (or equivalent)
Monomethylamine	GC with TCD detector, on PEG 400 or QUADROL column (or equivalent)